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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/706,033	11/13/2003	Se-Young Jang	1572.1194	6029
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STAAS & HALSEY LLP SUITE 700 1201 NEW YORK AVENUE, N.W. WASHINGTON, DC 20005				
			EXAMINER DUDA, KATHLEEN	
			ART UNIT 1756	PAPER NUMBER

DATE MAILED: 11/03/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/706,033

Applicant(s)

JANG, SE-YOUNG

Examiner

Kathleen Duda

Art Unit

1756

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 24 July 2006 and 17 August 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-18 is/are pending in the application.
- 4a) Of the above claim(s) 7-13 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-6 and 14-18 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                       | 5) <input type="checkbox"/> Notice of Informal Patent Application                       |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

### **DETAILED ACTION**

1. Claims 1-18 are pending in this application. In the reply filed on May 5, 2005, Applicant elected the invention of claims 1-6 and 14-18. Claims 7-13 are withdrawn from consideration.

### ***Claim Rejections - 35 USC § 102***

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1, 5, 6, 15-17 are rejected under 35 U.S.C. 102(e) as being anticipated by Datta (US 6,750,133).

Semiconductor structure 10 includes substrate 12 and metallization 14 such as a copper pad. Nitride layer 18 and passivation layer 20 are formed over substrate 12, corresponding to protective layers (col.2, 47-65, Fig.1). First metal layer 26 and second metal layer 28 are formed, corresponding to UBM (Fig.3, 4). The first metal layer may be Ti, Cr and Ti W, while the

second metal layer may be Cu (col.3, 26-col.4, 23). Figure 5 illustrates second mask 30, formed of a photoresist material. Copper stud 34 is plated over the first and second metal layers to a thickness of about 5 to about 15 microns (col.4, 30-59, Fig.6). Bump precursor 36 is plated over copper stud 34 through the second mask 30. The bump precursor may be a lead-free solder according to various lead-free solders as are known in the art (col.5, 14-50, Fig.7). The second mask 30 is removed and an etch process is performed to remove second metal layer 28 using the bump precursor and metal stud as a mask (col.5, 51-63, Fig.8, 9). An etch process is performed to remove first metal layer 26 using the bump precursor and metal stud as a mask (col.6, 44-50, Fig.10). The bump precursor is reflowed to form a solder ball 37 (col.7, 18-29, Fig.11). See also col.8, 10-32. Intermetallic material may form between the solder ball and the copper stud (i.e. copper diffusion). The presence of the copper stud causes the intermetallic zone to grow in shape and size (i.e. copper diffusion) and to act as a barrier to further tin migration. See col.7, lines 45-53.

### ***Claim Rejections - 35 USC § 103***

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject

matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 2 and 3 are rejected under 35 U.S.C. 103(a) as being unpatentable over Datta as applied to claim 1 above, and further in view of Cheung (US 6,638,847).

Datta teaches the solder bump may be a lead-free solder according to various lead-free solders as are known in the art but is silent on the specific material used for the solder bump and does not disclose the solder comprises tin or comprises tin and silver. Cheung teaches a method for forming lead free bump interconnections. Pure tin or tin alloys can be directly substituted for conventional lead-tin alloys, as such solders are considered more environmentally friendly than those including lead. Tin based solders can be formed to give well defined, regular bumps and are compatible with existing reflow processes and materials and with surface mount equipment and techniques. Examples of a tin alloy include tin-silver and tin-silver-copper (col.2, 8-col.3, 57). It would have been obvious to one of ordinary skill in the art to use tin or tin alloys such as tin-silver and tin-silver-copper for the lead-free solder in the method of Datta because Cheung teaches that such solder materials can be formed to give well defined, regular bumps, are compatible with existing reflow processes and materials

and are preferred over conventional solders because of the environmental problems associated with lead.

6. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Datta as applied to claim 1 above, and further in view of Darbha (US 5,904,555).

Datta teaches reflowing the solder but is silent on the specific reflow conditions and does not disclose performing the reflow for about 1 to about 20 minutes at a temperature of about 220 °C to about 270 °C. Darbha teaches that the time and temperature of a reflow process are generally determined according to the type of device being formed and the composition of the solder bumps (col.5, 11-26), thereby establishing the time and temperature of a solder reflow as result effective variables. It would within the ordinary skill of one in the art to determine the time and temperature of the solder reflow in the method Datta by routine experimentation and to perform the reflow for about 1 to about 20 minutes at a temperature of about 220 °C to about 270 °C, if required, because the solder reflow time and temperature are a result-effective variables, as taught by Darbha and the discovery of an optimum value of a result effective variable is ordinary within the skill of the art, as taught by *In re Boesch*, (617 F.2d 272, 205 USPQ 215 (CCPA 1980)).

7. Claims 14 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Datta as applied to claims 1 or 16 above, and further in view of Leibovitz (US 6,146,984).

Datta teaches reflowing after the etching of the UBM layer using the solder as a mask and does not exemplify the reverse. Leibovitz teaches a method for forming solder bumps wherein the UBM layer is etched using the solder material as a mask, after the removal of the photoresist layer. The selective etching of the UBM may be performed before or after the solder reflow (col.5, 17-27). It would have been obvious to one of ordinary skill in the art to perform the selective etching of the UBM layer after reflowing the solder in the method of Datta, instead of before, because Leibovitz teaches that the selective etching of the UBM may be performed either before or after the solder reflow.

### ***Response to Arguments***

8. Applicant's arguments filed July 24, 2006 have been fully considered but they are not persuasive. In regards to the 35 USC 102 rejection over Datta, Applicant argues that Datta does not teach a protective layer. Figure 2 and accompanying text, teach that **12** is the substrate, **14** is the copper metallization, **18** is a nitride layer and **20** is a passivation layer. Layers **18** and **20** are considered to be protective

layers by the examiner. These layers do not cover the copper (see Figure 2) which meets the limitations of the claims. Applicant argues that the claimed process does not include a nitride layer or etching process of Datta. The claims use open language ("comprising") which does not preclude additional steps in the process.

In regards to the 35 USC 103 rejections, Applicant argues that the references do not teach the entire process. The references were brought in for specific teachings as explained in the rejections. For example, Cheung was used in the 35 USC 103 rejection for its teaching of the solder bump composition. These references were used to correct for deficiencies in Datta.

### ***Conclusion***

9. Any inquiry concerning this communication should be directed to Examiner K. Duda at (571) 272-1383. Official FAX communications should be sent to (571) 273-8300.


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff, can be reached at 571-272-1385.

Information regarding the status of an application may be obtained from the Patent Application Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through



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Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

  
Kathleen Duda  
Primary Examiner  
Art Unit 1756